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Declaration

I, Michihiko Matsuba, President of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation of the copy of Japanese Unexamined Patent No. Hei-4-47769 laid open on February 17, 1992.

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IMAGE PICKUP DEVICE

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SPECIFICATION

1. TITLE OF THE INVENTION

IMAGE PICKUP DEVICE

2. WHAT IS CLAIMED IS;

1. An image pickup device comprising a phase optical filter, wherein

an image forming surface of the image pickup device is hermetically sealed by interposing the phase optical filter or the phase optical filter and another optical member, and a front surface of the phase optical filter or the other optical member, whereon dust can become attached, is spaced from the image forming surface by no less than a predetermined distance

at which degradation of image quality due to the dust is low.

3. DETAILED DESCRIPTION OF THE INVENTION

[Field of the Invention]

The present invention relates to an image forming device generally used in a video camera, electronic camera, or other image input device and relates particularly to a CCD or other image pickup device, with which occurrence of a false signal or moiré is prevented.

[Prior Art]

Generally with a video camera or other image pickup device, an incident optical image is sampled by means of sensors disposed at fixed intervals in a vertical direction and a horizontal direction, respectively.

Meanwhile, because an incident optical image captured by a video camera, etc., contains signals of various frequency components, there is a possibility of incidence of a signal with a frequency component equivalent to or greater than a pitch of the sensors. When such a signal enters the image pickup device, a false signal or a moiré pattern is generated. Image quality is thereby degraded remarkably.

An optical low-pass filter (optical LPF) is thus disposed along an optical axis of an image pickup lens and the image pickup device to remove frequency components corresponding to

the pitch of the sensor array of the image pickup device.

Examples of such optical LPFs include quartz LPFs, which make use of birefringence of quartz, and phase LPFs, surfaces of which are made to vary cyclically in a concave and convex manner (Japanese Unexamined Patent Publication No. Sho-55-38549), and phase LPFs are used in some cases for reasons of low cost, etc.

[Problems to be Solved by the Invention]

However, because a phase LPF is thin in plate thickness, an incidence surface thereof is positioned close to an image forming surface of the image pickup device, and when microscopic dust becomes attached to the incidence surface during manufacture, decrease of light amount and degradation of image quality occur due to influence of the microscopic dust.

It is also difficult to mount an optical LPF onto an image pickup device during manufacture without making microscopic dust become attached to the incidence surface of the optical LPF.

The present invention has been made in view of such circumstances and an object thereof is to provide an image pickup device that is easy to manufacture and enables degradation of image quality to be prevented.

[Means for Solving the Problems]

To achieve the above object, the present invention provides an image pickup device including a phase optical filter and characterized in that an image forming surface of the image pickup device is hermetically sealed by interposing the phase optical filter or the phase optical filter and another optical member, and a front surface of the phase optical filter or the other optical member, on which dust can become attached, is spaced from the image forming surface by no less than a predetermined distance at which degradation of image quality due to the dust is low.

[Action]

With the present invention, the image forming surface of the image pickup device is hermetically sealed by interposing the phase optical filter or the phase optical filter and the other optical member, and the front surface of the phase optical filter or the other optical filter, on which dust can become attached, can be spaced from the image forming surface by no less than a predetermined distance at which degradation of image quality due to the dust is low. Thus, even if microscopic dust becomes attached to the front surface, on which dust can become attached during manufacture, reduction of light amount does not occur and degradation of image quality does not occur.

[Preferred Embodiments]

Preferred embodiments of an image pickup device according to the present invention shall now be described according to the attached drawings.

FIG. 1 is a side view of a first embodiment of an image pickup device according to the present invention. A CCD 10 is disposed inside a recess of a CCD substrate 12, and this recess is formed by ribs 12A. Pins 14 of the CCD substrate 12 are electrically connected to a video camera substrate (not shown). A window glass 16 is affixed to the ribs 12A. The CCD 10 is thus hermetically sealed inside the recess.

A glass block 18 is affixed to the window glass 16, and a phase optical LPF 20 is affixed to the block 18. Because the glass block 18 is formed to have a predetermined thickness, the optical LPF 20 is disposed while being spaced by a predetermined interval (L) from an image forming surface 10A of the CCD 10.

FIG. 2 is a graph of relationships between a position of dust and a light amount received by the CCD 10. The dust position is indicated by the distance (dimension L in FIG. 1) from the image forming surface 10A of the CCD 10. The graph clearly shows that as the dust position becomes further away from the image forming surface 10A, the light amount increases and influence of the dust on the light amount lessens. For example,

when dust is present at a position no less than 4mm from the image forming surface 10A (that is, when the length L in FIG. 1 is set to no less than 4mm and dust becomes attached to a surface of the optical LPF 20), the received light amount of the CCD 10 is close to substantially 100 %.

Thus even if dust becomes attached to the surface of the optical LPF 20 in FIG. 1, because the optical LPF 20 is spaced by the predetermined distance (L) from the image forming surface 10A of the CCD 10, there is no influence of the dust when an image of incident light from an image taking lens 22 is formed on the image surface 10A via the optical LPF 20.

Curves shown in FIG. 2 are determined by a calculation formula under conditions of an aperture diameter of 1.14mm and an exit pupil position of 9.1mm and a curve in a case of dust with a size of 0.002mm is indicated by —, a curve in a case of dust with a size of 0.005mm is indicated by -·-, a curve in a case of dust with a size of 0.01mm is indicated by -···-, a curve in a case of dust with a size of 0.02mm is indicated by ---, and a curve in a case of dust with a size of 0.03mm is indicated by ---.

FIGS. 3 to 9 respectively show second to eighth embodiments of an image pickup device according to the present invention.

The second embodiment shown in FIG. 3 differs from the first

embodiment in that the glass 18 of the first embodiment is replaced by a color filter 30 and a glass 32, and the third embodiment shown in FIG. 4 differs from the first embodiment in that the glass 18 and the optical LPF 20 of the first embodiment are reversed in position. With the fourth embodiment shown in FIG. 5, the window glass 15 is eliminated from the third embodiment.

With the fifth embodiment shown in FIG. 6, an optical LPF 36, with a leg 34 formed thereon, is affixed to the window glass 16 in place of the glass 18 and the optical LPF 20 of the first embodiment. With the sixth embodiment shown in FIG. 7, an optical LPF 40, disposed at a substantially central portion of a leg 42, is affixed to the window glass 16 in place of the optical LPF 36, with the leg 34 formed thereon, of the fifth embodiment, and a window glass 44 is affixed to a front end of the leg 22.

With the seventh embodiment shown in FIG. 8, the window glass 16 is eliminated from the sixth embodiment, and with the eighth embodiment shown in FIG. 9, the window glass 16 is eliminated from the fifth embodiment.

In FIGS. 3 to 9, members that are the same as or similar to those of the first embodiment shown in FIG. 1 are provided with the same symbols and description thereof is omitted.

[Effects of the Invention]

As described above, with the image pickup device according to the present invention, because the image quality of an output screen does not become degraded due to microscopic dust that becomes attached during manufacture, assembly during manufacture can be facilitated.

4. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of a first embodiment of an image pickup device according to the present invention, FIG. 2 is a graph showing the effects in a case when using the image pickup device, and FIGS. 3 to 9 are side views respectively showing second to eighth embodiments of an image pickup device according to the present invention.

10 … CCD, 18, 32 … glass, 20, 36, 40 … optical LPF, 30 … color filter, 34, 42 … leg, 44 … window glass

FIG. 3

10 ... CCD, 18, 32 ... glass, 20, 36, 40 ... optical LPF, 30 ... color filter, 34, 42 ... leg, 44 ... window glass

FIG. 2

Light amount (%)

Position of dust (mm)